Claims

1.   A water-cooled mold for continuous metal casting, comprising two water-cooled wide copper plates which are arranged opposite to each other in front and back direction and two water-cooled narrow copper plates which are arranged opposite to each other in right and left direction; an upper portion of a cavity of the mold being a sprue area and a lower portion of the cavity being a mold cavity area, the sprue area being gradually narrowed in a casting direction and smoothly transited into the mold cavity, which corresponds to a shape of a slab to be cast; an inside surface of each of the water-cooled narrow copper plates being a smooth planar surface; a portion of an inside surface of each of the water-cooled wide copper plates that is in the sprue area being a curved surface, and a portion of the inside surface that is in the mold cavity area being a planar surface, the curved surface portion and the planar surface portion forming a continuous smooth surface; and a central point O_1 of a top face of the mold being an intersection point of a central axis of the mold with the top face of the sprue area,

characterized in that the curved surface portions of the cavity surfaces of the water-cooled wide copper plates are formed of such points P that they are intersection points of curves 1 and curves 2,

wherein the curves 1 are located in horizontal cross sections at different heights of the central axis of the mold, and are left-right symmetrical, a distance from a peak point of every curve 1 to the central axis being H+h, and a distance from a valley point of every curve 1 to the central axis being h; every curve 1 is composed of a curve segment in the middle and two linear segments at two opposite ends adjacent to the water-cooled narrow copper plates, each of the two linear segments having a length l_0, and the curve segment having a width L with

two opposite endpoints, p and q;

wherein the curves 2 are located in longitudinal sections parallel to the water-cooled narrow plates, every curve 2 is composed of an upper inclined linear segment with a slope k, a middle curve segment with a connection point m to the inclined linear segment, and a lower vertical linear segment parallel to the central axis with a length d_0 and a connection point n to the curve segment; in the mold, every curve 2 has an overall height $D+d_0$, and a distance between point m and point n projected on the central axis is d;

wherein the curves 1 meet the following equation:

$$f(x) = \sum_{i=0}^{n} a_i x^i$$

where n has a minimum value of 6, $a_i=f_i$ (H, L); f_i meets that the second derivatives at points p and q are continuous;

wherein the curves 2 meet the following equation:

$$f(x) = \sum_{j=0}^{m} b_j x^j$$

where m has a minimum value of 5, $b_j=f_i$ (D, d, k); f_i meets that the second derivatives at points m and n are continuous.

2.   The water-cooled mold for continuous metal casting according to Claim 1, wherein l_0 is 0.

3.   The water-cooled mold for continuous metal casting according to Claim 1, wherein d_0 is 0.

4.   The water-cooled mold for continuous metal casting according to any one of Claims 1 to 3, wherein the curve segment of the profile curves in horizontal cross sections of the cavity of the mold is expressed by the equation: $f(x) = a_0 + a_1 x$

$+a_2x^2 +a_3x^3 +a_4x^4 +a_5x^5 +a_6x^6$.

5.   The water-cooled mold for continuous metal casting according to any one of Claims 1 to 3, wherein the curve segment of the profile curves in vertical longitudinal sections of the cavity of the mold is expressed by the equation: $f(z)= b_0 +b_1z +b_2z^2 +b_3z^3 +b_4z^4 +b_5z^5$.

6.   The water-cooled mold for continuous metal casting according to any one of Claims 1 to 3, wherein the third and higher order derivatives at point p and q are continuous.

7.   The water-cooled mold for continuous metal casting according to any one of Claims 1 to 3, wherein the third and higher order derivatives at point m and n are continuous.

8.   The water-cooled mold for continuous metal casting according to Claim 1, wherein a ratio of the length of a profile curve of a horizontal cross section of an upper opening of the mold to the length of the linear lines which adjoin the two opposite ends of the curve is selected to be between 1.02 and 1.15, and the length variation of the profile curves of horizontal cross sections in the height direction of the mold is in the form of curvedly and unevenly shortening.

9.   The water-cooled mold for continuous metal casting according to Claim 1, wherein an inclination angle at which the upper portion of each water-cooled wide copper plate opens upwards and outwards is less than 12° .

10.   The water-cooled mold for continuous metal casting according to Claim 1, wherein a ratio of an upper opening width to a lower opening width of each of the two narrow water-cooled copper plates is selected to be 1.0 - 1.05.